

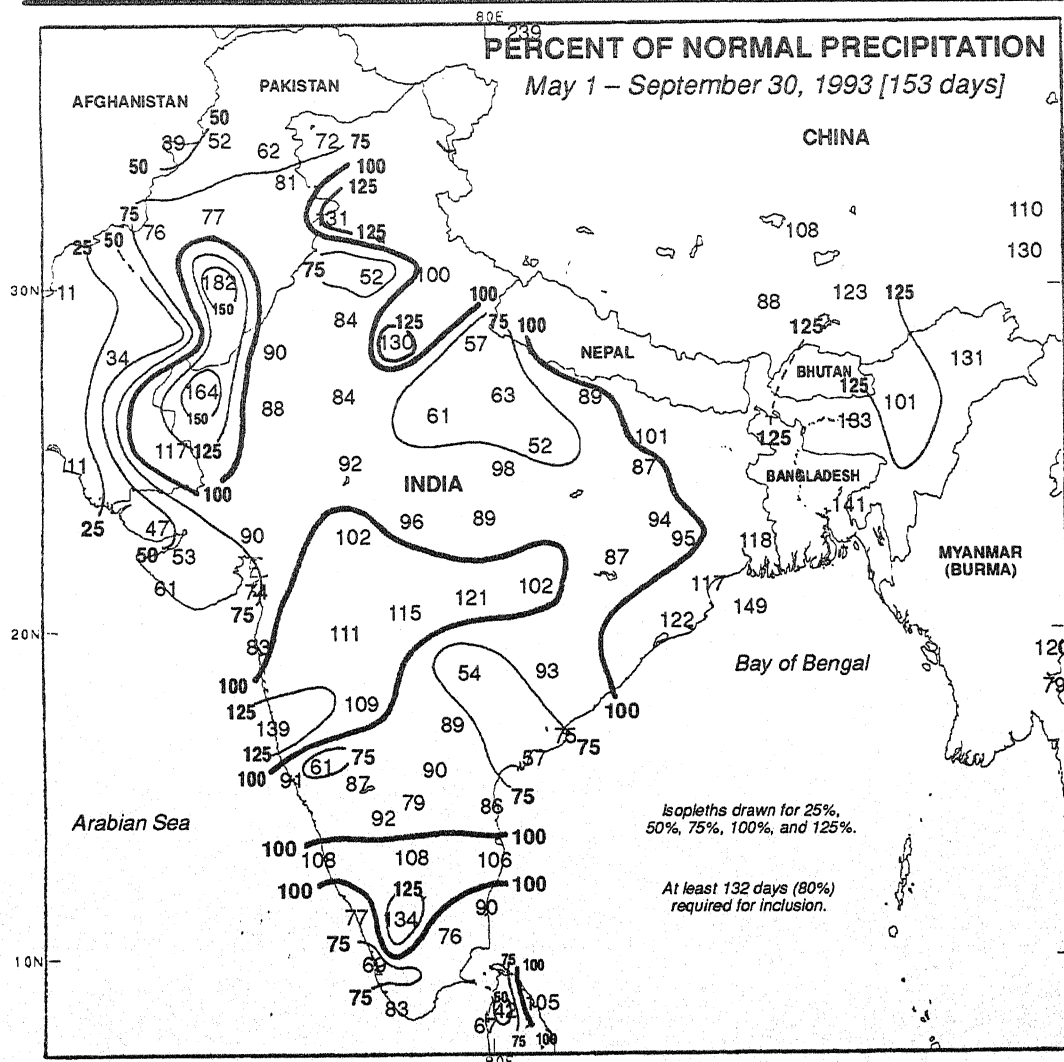
CONTAINS:
SUMMARY OF
THE 1993
INDIAN
MONSOON
AND AFRICAN
SAHEL RAINY
SEASON

WEEKLY CLIMATE BULLETIN

No. 93/40

Washington, DC

October 6, 1993



HEAVY RAINS AND SEVERE FLOODING HIGHLIGHT THE 1993 INDIAN MONSOON. Following a favorably moist start, excessive rains triggered some of the century's worst flooding during July and early August across the northern and eastern tiers of the Indian Subcontinent. According to press reports, over 1,000 individuals perished across India and nearly 600 lives were lost in Bangladesh; however, the mountains of central and eastern Nepal were most severely affected. Between 3,000 and 12,000 people died in that country as entire villages were buried by landslides or submerged by rising rivers, resulting in the worst national disaster, in terms of material damage, in Nepal's history. As the season progressed, the rest of August provided relief for most of the flooded regions. Conditions, however, deteriorated in September, with more flooding reported. Over 260 individuals perished in Uttar Pradesh as over 310 mm of rain fell in one late September night near Bombay. Elsewhere, the heaviest rains in five years generated severe flash flooding in Dhaka, Bangladesh, and renewed rains forced rivers out of their banks in western Nepal. In sharp contrast, a few sections of India endured an unfavorably dry monsoon season, deleteriously affecting some crops across the central tier of the country. For more details, refer to the Special Climate Summary on pp. 5-8.



UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE-NATIONAL METEOROLOGICAL CENTER
CLIMATE ANALYSIS CENTER



WEEKLY CLIMATE BULLETIN

This Bulletin is issued weekly by the Climate Analysis Center and is designed to indicate, in a brief concise format, current surface climatic conditions in the United States and around the world. The Bulletin contains:

- Highlights of major climatic events and anomalies.
- U.S. climatic conditions for the previous week.
- U.S. apparent temperatures (summer) or wind chill (winter).
- Global two-week temperature anomalies.
- Global four-week precipitation anomalies.
- Global monthly temperature and precipitation anomalies.
- Global three-month precipitation anomalies (once a month).
- Global three-month temperature anomalies (once a month).
- Global twelve-month precipitation anomalies (every three months).
- Global twelve-month temperature anomalies (every three months).
- Special climate summaries, explanations, etc. (as appropriate).

Most analyses contained in this Bulletin are based on preliminary, unchecked data received at the Climate Analysis Center via the Global Telecommunications System. Similar analyses based on final, checked data are likely to differ to some extent from those presented here.

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GLOBAL CLIMATE HIGHLIGHTS

MAJOR CLIMATIC EVENTS AND ANOMALIES AS OF OCTOBER 2, 1993

1. Alaska:

ABNORMALLY HEAVY PRECIPITATION OBSERVED

Since late August, between 495 and 730 mm of precipitation inundated south-central sections of the state, with totals of 80–300 mm representing twice to three times the normal across most other areas, where normals are lower [5 weeks].

2. West-Central North America:

WET SEASON STARTS SLOWLY

Typically, precipitation increases across west-central North America from late August through autumn, reaching a maximum around mid-winter. Since late August 1993, however, totals have lagged behind the typical seasonal values. Little or no precipitation fell during the last six weeks through southern and eastern sections, with amounts of up to 175 mm representing under half of normal through the remainder of the area [6 weeks].

3. Central United States:

A RELATIVELY DRY WEEK

Little or no precipitation was recorded at most locations, engendering some relief for the saturated region. Locally heavy rain fell on parts of the southern tier, with 35–85 mm measured across southern Missouri and totals of 170–220 mm soaking isolated sections of southwestern Arkansas and adjacent Oklahoma [Ending after 33 weeks].

4. Central Gulf Coast:

RAINFALL DEFICITS PERSIST

Moderate rains brought limited, localized relief to parts of eastern Texas (up to 35 mm) and central and western Louisiana (25–80 mm). Farther east, however, little or no rain was reported from southeastern Louisiana to east-central Florida. Since mid-August, rainfall shortages of 100–140 mm accumulated through eastern Texas and along the central Gulf Coast [14 weeks].

5. Central South America:

UNSEASONABLY COLD CONDITIONS SPREAD

Large sections of central South America reported temperatures averaging 3°C to 6°C below normal last week, particularly through southern Bolivia and central and northern Argentina [7 weeks].

6. Uruguay:

DRY WEATHER CONTINUES

Although 50–100 mm of rain ended the recent dry anomaly across southern Paraguay, subnormal rainfall persisted through central and western Uruguay. Between 20 and 40 mm of rain dampened most of Uruguay last week, with totals under 20 mm measured in southern and western parts of the country [14 weeks].

7. Western Europe:

WIDESPREAD WETNESS ENVELOPES REGION

Moderate rains (20–50 mm) fell on most of the region for the fourth successive week, but 50–80 mm soaked northwestern Spain, southern and western France, Switzerland, coastal sections of the Benelux nations, and southern parts of England and Ireland. Furthermore, excessive rains of 80–200 mm engendered more flooding through parts of the Alps and much of central and northern Italy. Six week surpluses reached 390 mm in Italy, ranged between 245 and 345 mm across the Alps, and were 50–200 mm through France. In contrast, a relatively dry week ended the wet spell east of western Austria [4 weeks].

8. The Baltic States and Western C.I.S.:

COLD AIR REMAINS ENTRENCHED

Temperatures moderated across Scandinavia, but averaged 4°C to 7°C below normal elsewhere as the cold snap continued [7 weeks].

9. Southeastern China:

LOCALIZED MOISTURE SURPLUSES CONTINUE

Between 70 and 125 mm of rain fell along the immediate southeastern coast last week, with 20–50 mm observed elsewhere. Six-week surpluses were as large as 260 mm near the coast, but were significantly lower across the remainder of the area [Ending after 9 weeks].

10. Southern Japan:

RAINFALL DECLINES

Moderate rains of 30–75 mm dampened most of Kyushu while 20–60 mm fell on the rest of southern Japan, allowing surpluses to drop. Portions of Kyushu, however, still reported six-week excesses approaching 260 mm [Ending after 16 weeks].

11. Taiwan and the Southern Ryukyus:

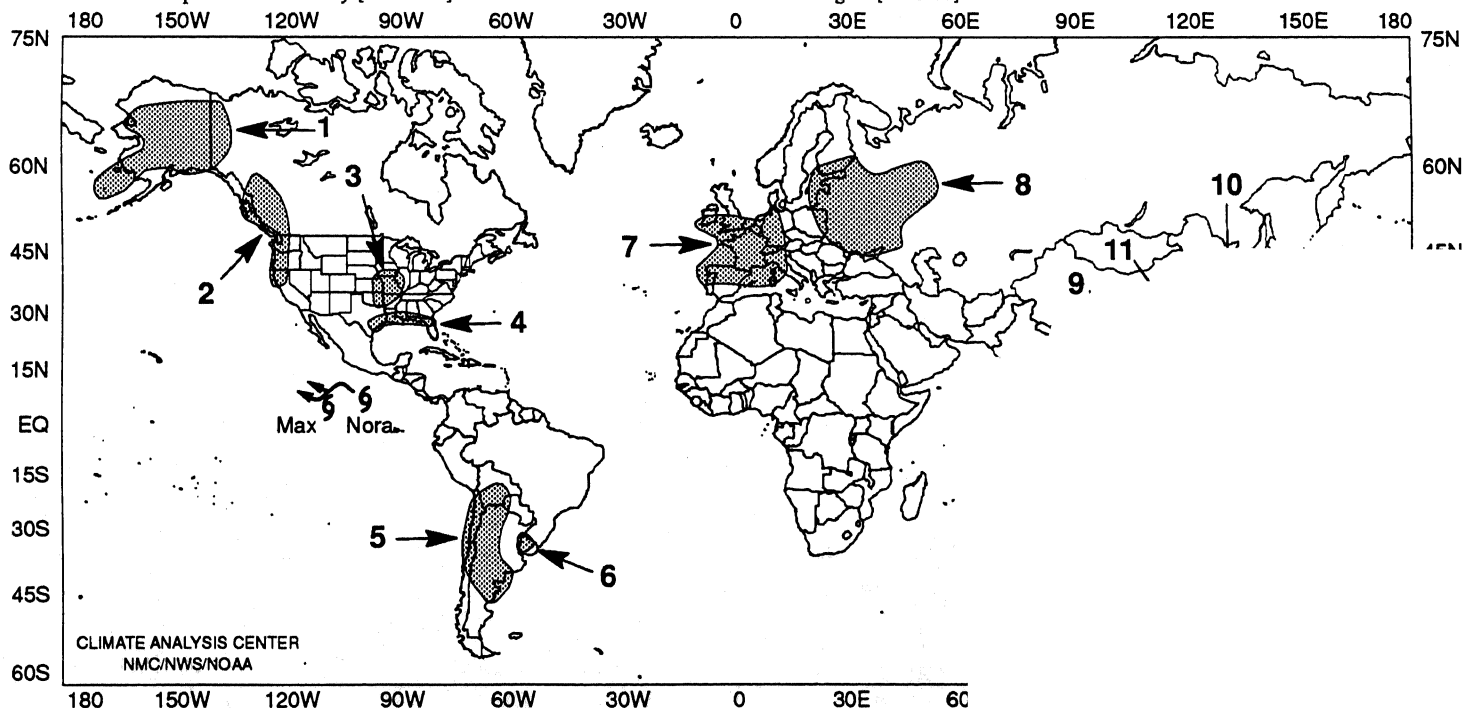
SCATTERED SHOWERS BRING LIMITED RELIEF

Portions of northern Taiwan received 50–80 mm of rain, but only 10–30 mm fell over the rest of the area, keeping moisture deficits intact [16 weeks].

12. Southeastern Australia:

HEAVY PRECIPITATION ABATES SOMEWHAT

Light to moderate precipitation (10–50 mm) was widespread across the southeastern quarter of the nation last week, generating surpluses of 50–95 mm at most places since mid-August [5 weeks].



EXPLANATION

TEXT: Approximate duration of anomalies is in brackets. Precipitation amounts and temperatures are in degrees Celsius. MAP: Approximate locations of major anomalies and episodic events are shown. See other pages for temperature anomalies, four week precipitation anomalies, long-term anomalies, and

UNITED STATES WEEKLY CLIMATE HIGHLIGHTS

FOR THE WEEK OF SEPTEMBER 26 – OCTOBER 2, 1993

A series of strong cold fronts pushed across the eastern two-thirds of the nation, spreading moderate to heavy rain from the southeastern Plains and lower Mississippi Valley northeastward to the Great Lakes, Northeast, and middle Atlantic coast, spawning severe weather over portions of the Southeast and mid-Atlantic, and ushering cold Canadian air into the much of the eastern half of the country. On Monday, violent thunderstorms ahead of an eastward-moving cold front spawned tornadoes in northern Virginia, Delaware, and eastern Pennsylvania. A pair of twisters smashed mobile homes, ripped the roofs off houses, and knocked down power lines (leaving 15,000 customers without electricity) in northern Delaware, according to press reports. Subsequent cold fronts moved quickly across the central United States, generating only light precipitation. At week's end, however, subtropical moisture fueled showers and strong thunderstorms, with locally heavy rain, from the southeastern Plains northeastward to western New England ahead of slow southeastward-moving cold front. Unseasonably cool air settled southward out of Canada behind each front, with nearly a dozen daily record low temperatures set in the upper Great Lakes and Ohio Valley on Thursday and nearly two dozen record lows broken in the upper Ohio Valley and Atlantic Coast States on Friday. Subfreezing temperatures dipped southward into portions of the central Plains, Ohio Valley, and central Appalachians. In contrast, abnormally warm weather persisted in the Far West, where a number of daily high temperature records were established during the week. Hot and dry conditions engendered several wildfires in southern California, where over 4,500 acres were charred, according to press reports.

At the beginning of the week, showers and severe thunderstorms accompanied by hail, high wind, and locally heavy rain developed along a slow eastward-moving frontal system extending from eastern Texas to the Northeast. In the warm, muggy air ahead of the system, intense thunderstorms produced strong wind gusts that downed trees and power lines across northern Alabama while daily record high temperatures were observed in eastern Texas, Louisiana, and North Carolina. Farther west, showers and thunderstorms were widely scattered along a cold front that moved across the upper Great Lakes, Mississippi Valley, and central and southern Plains. By Tuesday, the eastern cold front moved into the Atlantic Ocean, central Florida, and the Gulf of Mexico after spreading severe weather and heavy rain across the East. The second cold front dissipated after

crossing into the lower Great Lakes and western mid-Atlantic while a third cold front moved quickly southeastward, generating showers across the Great Lakes and upper Mississippi Valley.

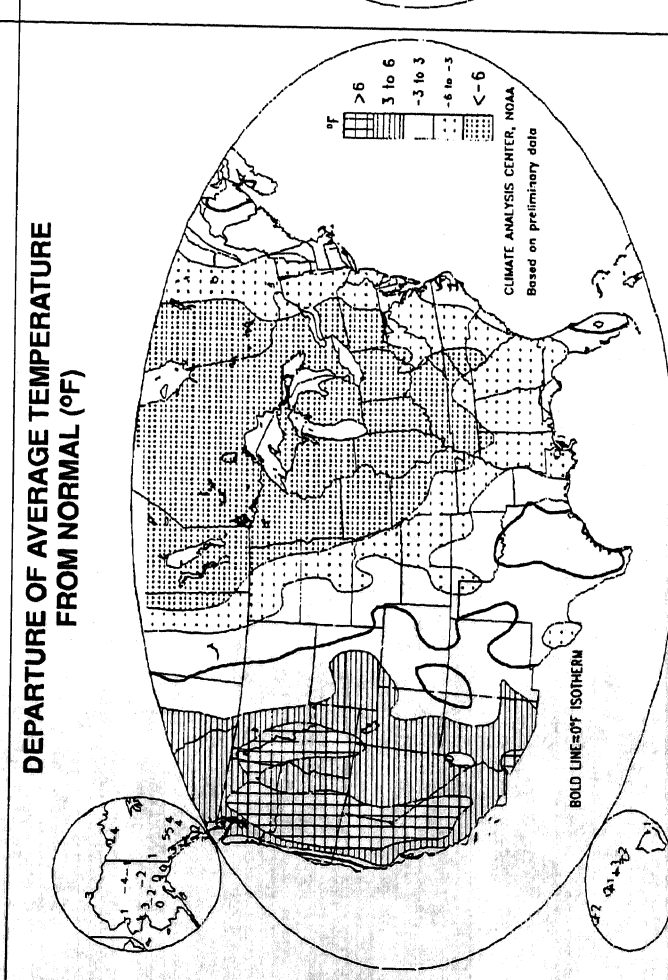
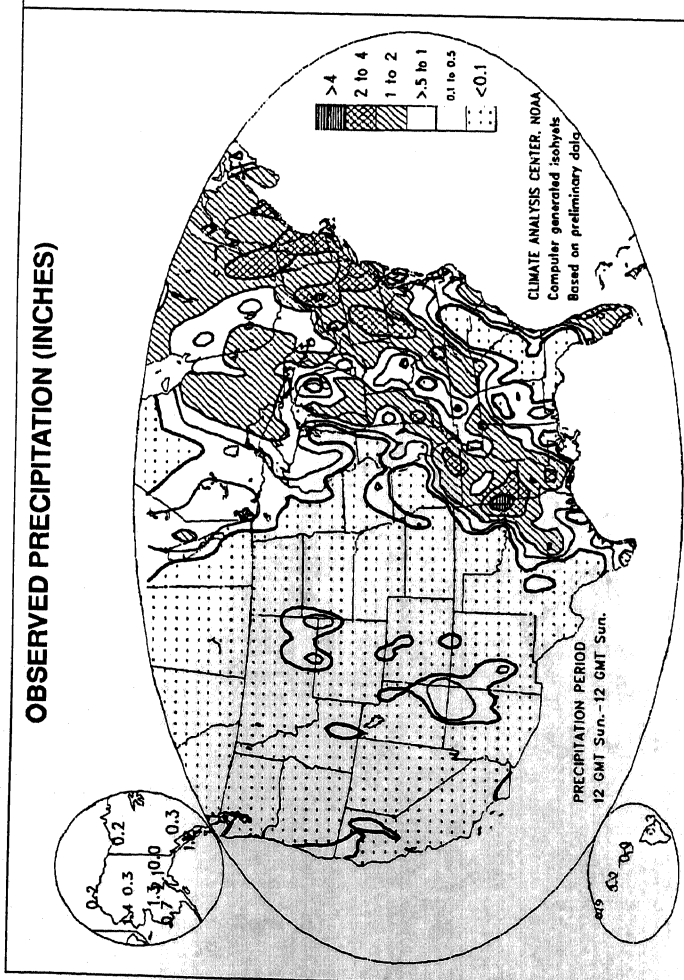
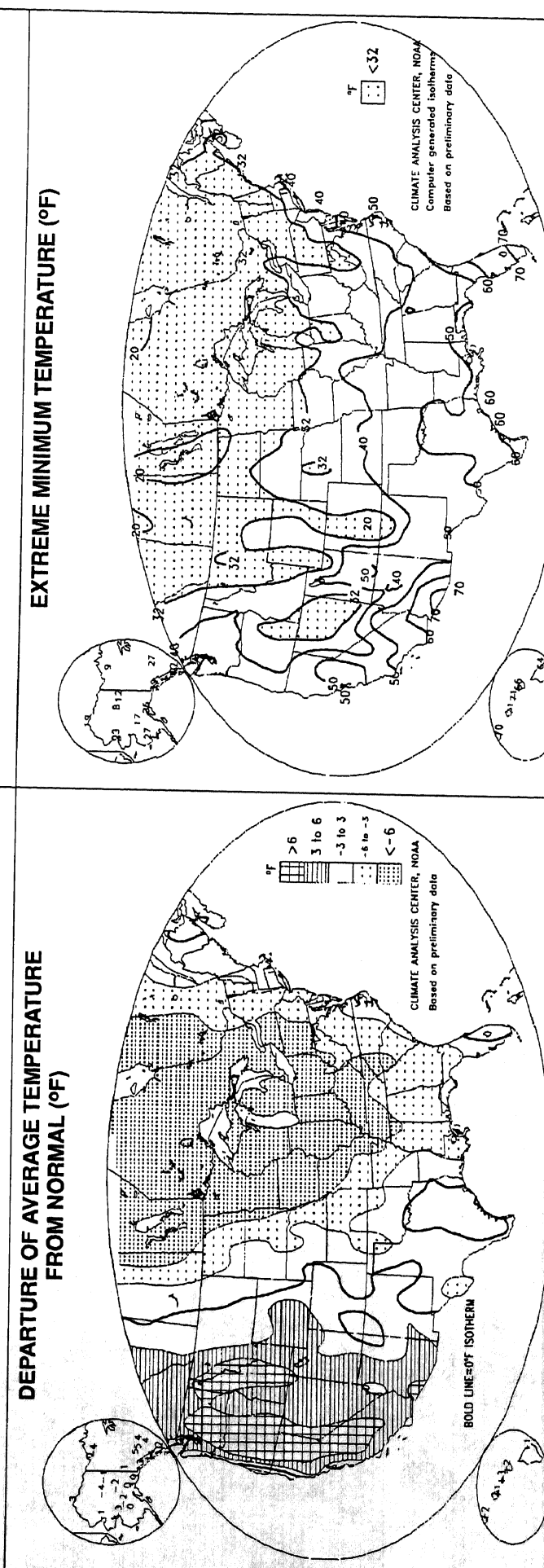
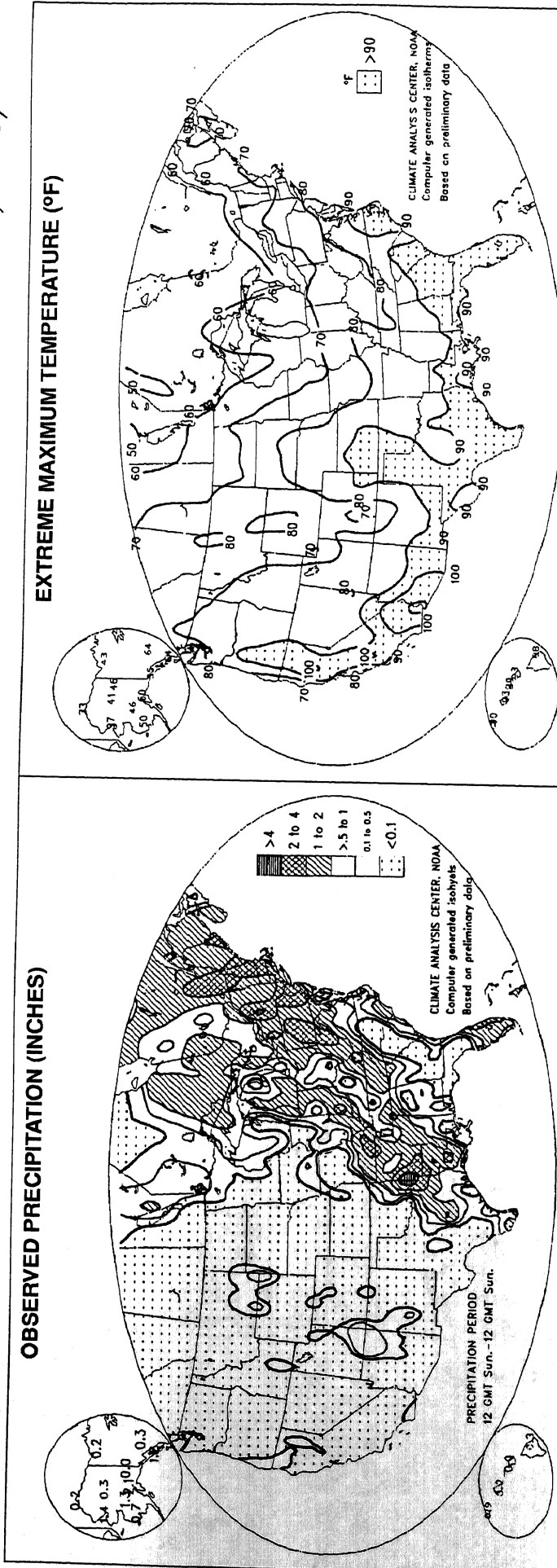
At mid-week, rainfall was limited to southern Florida (in thunderstorms along and south of the eastern front) and scattered locations across the Great Lakes and Northeast as the western cold front gradually dissipated. During the latter part of the week, yet another front sped rapidly southeastward out of Canada across the northern and central sections of the Rockies and Plains and into the Great Lakes, middle Mississippi Valley, and southern Plains. The front produced only widely scattered showers until the weekend, when strong thunderstorms erupted along and ahead of the front from the southeastern Plains northeastward to the lower Great Lakes and New England. In Hawaii, heavy rain showers caused local flooding on the island of Kauai.

According to the River Forecast Centers, the greatest weekly precipitation totals (between two and nine inches) fell from the southeastern Plains northeastward to the lower Ohio Valley and across much of the Appalachians, New England, the northern mid-Atlantic, and southern Florida. In addition, scattered totals exceeding two inches were reported across the lower Mississippi Valley, the Great Lakes, western Hawaii, and southern Alaska. Light to moderate amounts were measured in the Rockies and the remainders of the Great Plains, Alaska, and the eastern half of the nation. Little or no precipitation was reported in the Far West, much of the Intermountain West, and the remainder of Hawaii.

Warmer than normal conditions prevailed over the western third of the nation and portions of southeastern Texas and southeastern Florida, with weekly departures of +6°F to +8°F covering the interior Far West and portions of the Intermountain West. Abnormally warm weather also prevailed over south-central, southeastern, and northern Alaska, with weekly departures reaching +4°F at Barrow, Sitka, and Juneau. Temperatures averaged a few degrees above normal across most of Hawaii.

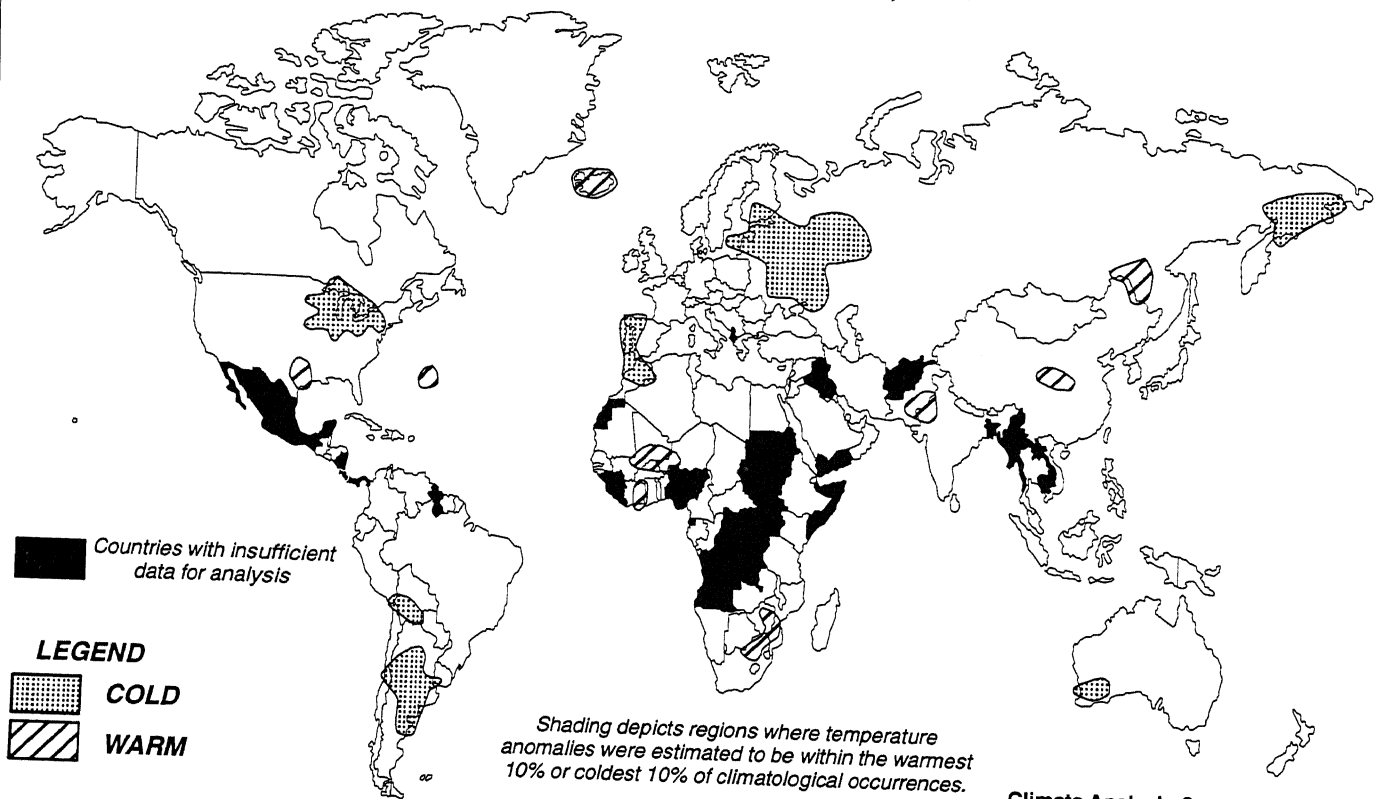
Temperatures were well below normal over most of the remainder of the country, with weekly departures ranging from -5°F to -12°F in the northeastern Plains, the upper and middle Mississippi, Ohio, and Tennessee Valleys, the Great Lakes, and the Appalachians. Below normal temperatures also dominated the remainder of Alaska, with weekly departures reaching -4°F at Bettles.

UNITED STATES WEEKLY CLIMATE CONDITIONS (September 26 – October 2, 1993)



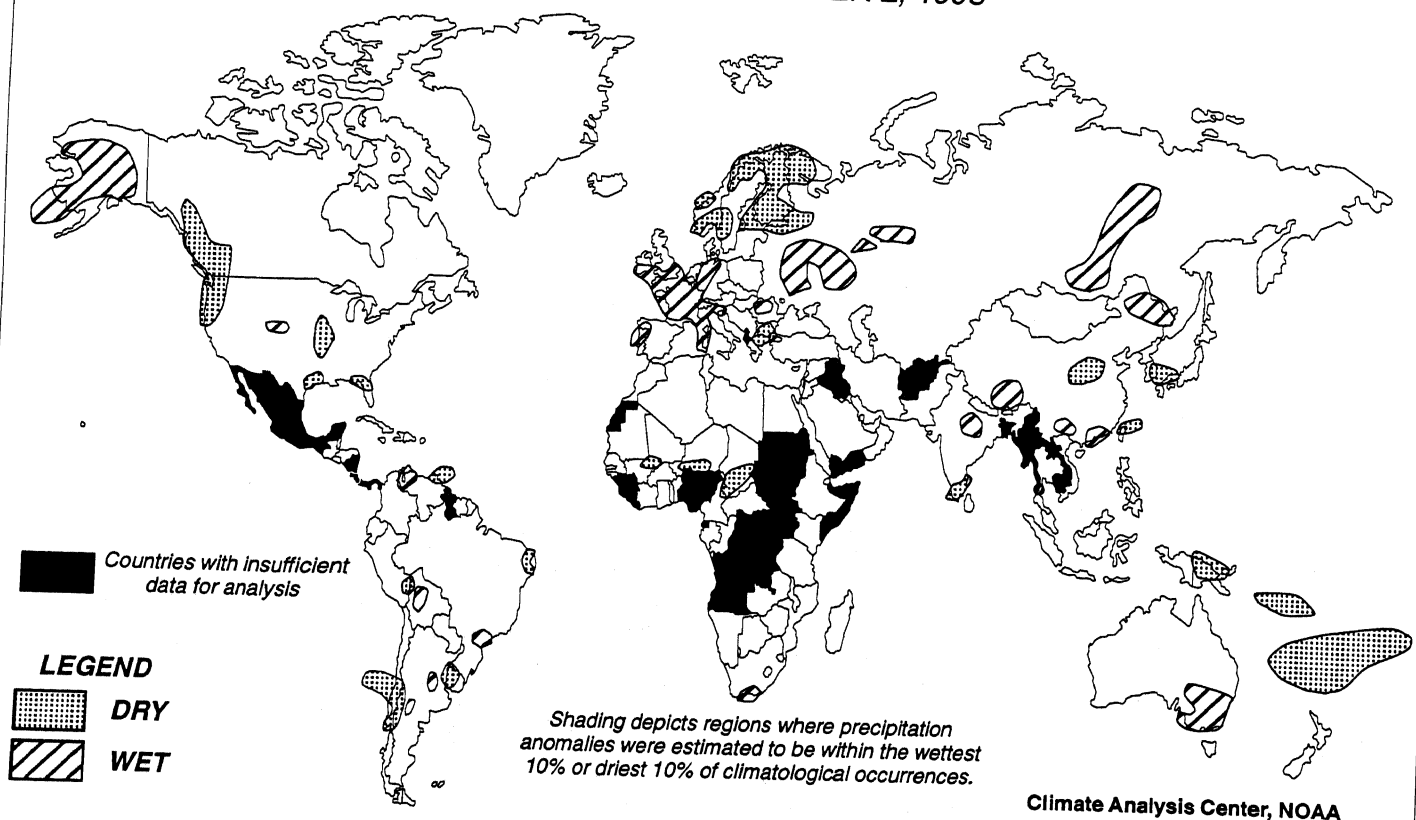
TWO-WEEK GLOBAL TEMPERATURE ANOMALIES

SEPTEMBER 19 – OCTOBER 2, 1993



FOUR-WEEK GLOBAL PRECIPITATION ANOMALIES

SEPTEMBER 5 – OCTOBER 2, 1993



SPECIAL CLIMATE SUMMARY

ANALYSIS AND INFORMATION BRANCH

CLIMATE ANALYSIS CENTER, NMC

NATIONAL WEATHER SERVICE, NOAA

SUMMARY OF THE 1993 INDIAN MONSOON AND AFRICAN SAHEL RAINY SEASON

Contrasting conditions dominated the 1993 Indian monsoon and African Sahel rainy season. Severe flooding generated most of the meteorological news across the Indian Subcontinent while a subnormal rainy season was observed in large sections of sub-Saharan Africa, particularly Ethiopia, central Chad, south-central Niger, Côte d'Ivoire, Liberia, Sierra Leone, Guinea, southwestern Mali, and southern Mauritania during July and August.

INDIAN MONSOON: The month of August brought a slow decrease in the degree of serious flooding afflicting the northern and eastern tiers of the Indian Subcontinent (for more details on July and early August's serious flooding and other information about the Indian monsoon and African Sahel wet season through late July, refer to the front cover of this Bulletin and to the Weekly Climate Bulletin #93/30, dated July 28, 1993). Scattered, occasional flood-related problems, however, continued affecting the region. A landslide in early August took 50 lives in west Bengal and destroyed nearly 100 dwellings near Calcutta, according to press reports. Meanwhile, new floods swept through Bangladesh, particularly along the Bakkhali River near Chittagong and in Sirajgong, and flooding and landslides wrought havoc through Nepal, especially across the southwestern areas. The renewed rains prolonged the isolation of Nepal's capital (Katmandu), which remained inaccessible by road for over three weeks, according to press reports.

The last half of August brought more rapidly improving conditions to the flooded areas across the northern and eastern tiers of the Indian Subcontinent. By August 15, floods had generally receded across northern India, but Nepal, extreme northeastern India, and Bangladesh continued to experience localized flood-related difficulties. During August 17–23, renewed river flooding swept through Bangladesh, primarily fueled by heavy rains across northern India. The Halda, Matamuhuri, and Bakkhali Rivers all rose above flood stage, inundating roads and railways out of Chittagong and destroying 75,000 dwellings. Through the rest of the subcontinent, however, rains tapered off to near or below seasonable levels.

While large sections of the region reeled from the affects of flooding, acutely dry conditions gripped the western and central sections of the subcontinent. Floods inflicted over \$700 million (U.S.) in Punjab alone, according to media reports, but a lack of rainfall deleteriously affected crops to some extent through parts of Gujarat, Uttar Pradesh, Madhya Pradesh, and Bihar. Despite these difficulties, and despite flood-related crop damage in other sections of India, a record or near-record yield of crops was anticipated by the Agriculture Ministry, up approximately four percent from the previous year.

Rainfall typically starts declining in September, particularly across the northern half of the subcontinent, but heavy rains persisted through most of the month across the eastern two-thirds of the region. Furthermore, additional flood-related problems were precipitated through the northern and eastern tiers of the subcontinent. Early in September, over a dozen lives were lost in and near Arunchal Pradesh in extreme northeastern India as floods and landslides stranded 25,000 travelers in the mountains near Tibet, according to press reports. Farther south, the largest daily rainfall total in five years was reported in Dhaka, Bangladesh (140 mm, according to press reports), fueling a widespread flood that brought the city to a standstill.

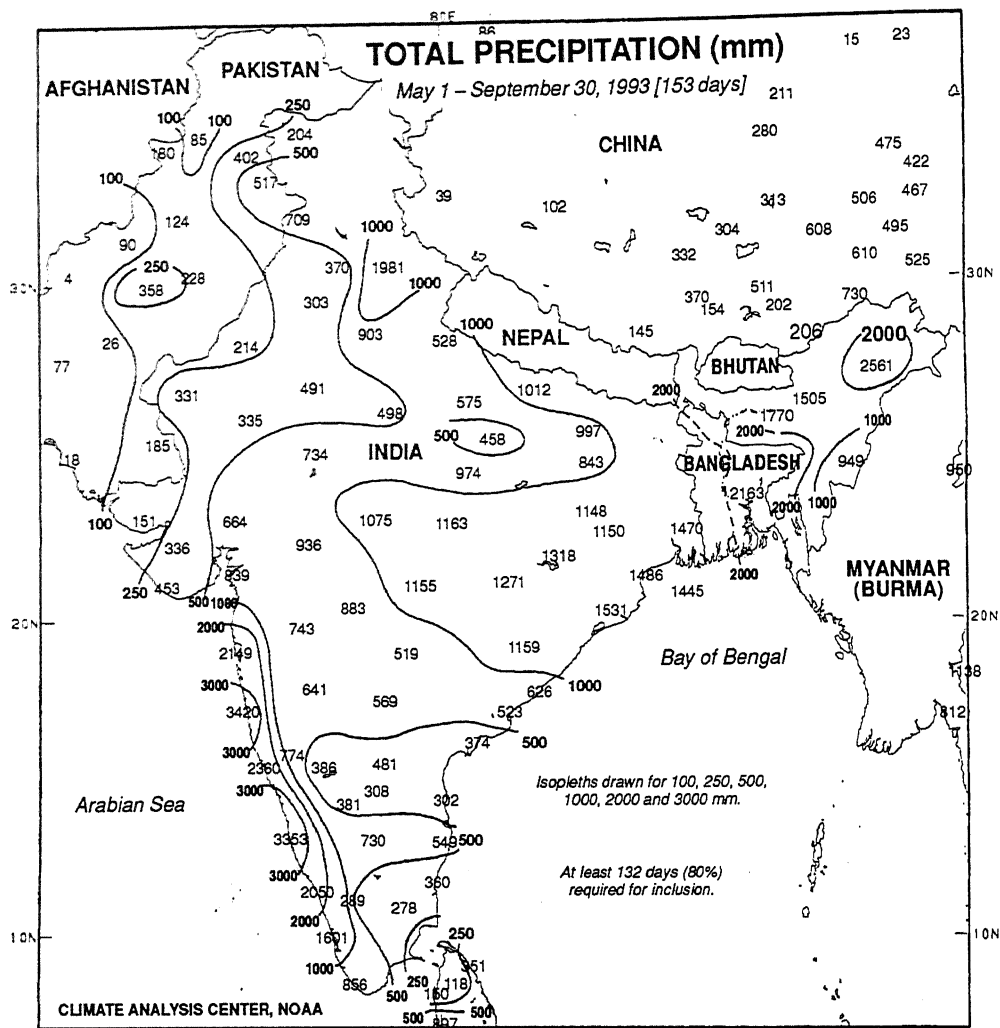
The second and third weeks of September brought renewed flooding to northern Uttar Pradesh and southwestern Nepal. Over 250 individuals perished as the Ram Ganga River rose to 1.5 meters above flood stage, according to press reports. This episode engendered approximately \$500 million (U.S.) in damage to buildings, crops, and livestock. Later in the month, the decade's worst rains dropped over 310 mm of rain on Bombay in one night, generating severe flash flooding that took over a dozen lives and submerged more than 3500 dwellings, according to press reports. More flooding also washed across northern Bangladesh as up to 130 mm of rain soaked some locations within 24 hours. As the month ended, heavy rains, with weekly totals generally in the 20–80 mm range, continued to fall to the south and east of north-central India. The wet weather hampered cleanup and rescue operations in the wake of the subcontinent's deadliest earthquake since 1935, which took 20,000 to 30,000 lives in Maharashtra.

For the season as a whole, above normal rainfall was widespread through extreme northeastern India, east-central India, Bangladesh, much of south-central and west-central India, central and eastern Nepal, northern India, western Rajasthan, and eastern Pakistan (see front cover). In contrast, subnormal rains were reported through northern Pakistan, Uttar Pradesh, central and eastern Rajasthan, Gujarat, northern and eastern Madhya Pradesh, western Bihar, northern Karnataka, northern Andhra Pradesh, Kerala, central and southern Tamil Nadu, and central and western Sri Lanka. Although deficits were not exceptionally large at most afflicted locations, and despite timely rains which minimized the affects of the dryness, only about half of the normal seasonal amounts fell on northern Pakistan, northern and eastern Uttar Pradesh, southern Madhya Pradesh, central and western Gujarat, northern Andhra Pradesh, and central Sri Lanka. Observed rainfall totals were typically variable, ranging from under 100 mm across northern and western Pakistan to over 3,000 mm along the southwestern coast (see page 6). The retreat of the monsoonal rains was generally "on schedule" (with respect to the climatologically typical retreat), with rains extending into north-central India on October 1 but receding rapidly southeastward during the ensuing few days.

AFRICAN SAHEL WET SEASON (NOTE – Reliable surface rainfall measurements are lacking through large sections of the African Sahel. Estimated precipitation totals based on a blend of available surface reports and METEOSAT satellite images were employed where surface data appeared suspect or was not reported) As of late July, exceptionally dry conditions dominated large sections of sub-Saharan Africa (especially across the western half of the region) as the Inter-Tropical Convergence Zone (ITCZ) remained considerably south of the climatologically typical location. The dryness was most acute across northern Senegal, southwestern Mauritania, southwestern Mali, southeastern Guinea, south-central and central Niger, and central and southwestern Chad, where approximately half of normal rainfall or less was reported. Only a few millimeters of rain had been measured across the northwestern Sahel.

During the last two months, rains across the northern tier of the Sahel increased significantly, although few locations completely eliminated the deficits that had accumulated through July (see page 7). The most significant improvement was reported across northern Senegal and southwestern Mauritania. Only a few millimeters had fallen through late July, but by the end of September season-to-date totals generally ranged from 135 to 375 mm (see page 8), which is approximately normal for the area. Similar but less marked relief came to the aforementioned dry locations, increasing seasonal totals to at least 80% of normal, except across southwestern Mali, south-central and southeastern Mauritania, southern Niger, and central and southwestern Chad. Farther south, moisture deficits continued throughout the wet season across southwestern sub-Saharan Africa (Guinea, Sierra Leone, Liberia, Côte d'Ivoire, and southern Ghana). Only 45%–85% of normal seasonal totals was reported, with August bringing particularly dry conditions to Liberia, central and southern Côte d'Ivoire, eastern Guinea, and western and coastal Ghana, where only 10%–50% of normal monthly rains fell. Farther east, a favorably moist wet season through late July deteriorated during August and September, leaving seasonal rainfall amounts at only 60%–85% of normal across eastern sections of the Central African Republic and portions of Ethiopia.

Wet season rainfall totals were near to above normal elsewhere. Significant impacts resulting from abnormally wet conditions were few and far between as only isolated locations in southern Senegal, central Burkina Faso, central Mali, central Niger, southern Cameroon, and central and northwestern Kenya received over 120% of the May–September normal. In early August, flooding along the Blue Nile in Sudan (where surface rainfall reports have been lacking throughout the season) forced sharp cuts in the nation's hydroelectric power production, according to press reports. In late September, heavy rains flooded farmlands and left over 10,000 people homeless in northern Ghana. Several square kilometers of farmland were completely submerged for a short time.



MEAN DATES OF THE SOUTHWEST MONSOON'S RETREAT

